Special Report

National Study of Physician Awareness and Adherence to Cardiovascular Disease Prevention Guidelines

Lori Mosca, MD, MPH, PhD; Allison H. Linfante, EdD; Emelia J. Benjamin, MD, ScM; Kathy Berra, MSN, ANP; Sharonne N. Hayes, MD; Brian W. Walsh, MD; Rosalind P. Fabunmi, PhD; Johnny Kwan, MS; Thomas Mills, MA; Susan Lee Simpson, PhD

Background—Few data have evaluated physician adherence to cardiovascular disease (CVD) prevention guidelines according to physician specialty or patient characteristics, particularly gender.

Methods and Results—An online study of 500 randomly selected physicians (300 primary care physicians, 100 obstetricians/gynecologists, and 100 cardiologists) used a standardized questionnaire to assess awareness of, adoption of, and barriers to national CVD prevention guidelines by specialty. An experimental case study design tested physician accuracy and determinants of CVD risk level assignment and application of guidelines among high-, intermediate-, or low-risk patients. Intermediate-risk women, as assessed by the Framingham risk score, were significantly more likely to be assigned to a lower-risk category by primary care physicians than men with identical risk profiles ($P<0.0001$), and trends were similar for obstetricians/gynecologists and cardiologists. Assignment of risk level significantly predicted recommendations for lifestyle and preventive pharmacotherapy. After adjustment for risk assignment, the impact of patient gender on preventive care was not significant except for less aspirin ($P<0.01$) and more weight management recommended ($P<0.04$) for intermediate-risk women. Physicians did not rate themselves as very effective in their ability to help patients prevent CVD. Fewer than 1 in 5 physicians knew that more women than men die each year from CVD.

Conclusions—Perception of risk was the primary factor associated with CVD preventive recommendations. Gender disparities in recommendations for preventive therapy were explained largely by the lower perceived risk despite similar calculated risk for women versus men. Educational interventions for physicians are needed to improve the quality of CVD preventive care and lower morbidity and mortality from CVD for men and women. **(*Circulation*. 2005;111:499-510.)**

Key Words: cardiovascular diseases ■ guidelines ■ prevention ■ risk assessment ■ women

Cardiovascular disease (CVD) is the leading killer of both men and women in the United States.[1] Sex disparities in CVD outcomes in women have been widely documented, yet the mechanisms remain unclear.[2] In numerous studies, women have been shown to receive suboptimal CVD preventive care, which may contribute to worse outcomes compared with men.[3–8] To address this important public health issue, the American Heart Association (AHA) released "Evidence-Based Guidelines for Cardiovascular Disease Prevention in Women" in February 2004 to assist healthcare providers in determining appropriate preventive care based on a woman's future risk of coronary heart disease (CHD).[9]

Successful adoption of practice guidelines has been shown to be related to physician awareness/agreement, self-efficacy, outcome expectancy, and practice habits/routines, in addition to patient- and system-related factors.[10] Few data have systematically assessed physicians' reasons for nonadherence and barriers to adoption of guidelines specific to CVD prevention. Moreover, most disparities research has not used a controlled or experimental design to evaluate possible gender-based differences in preventive practice patterns. An understanding of the barriers may potentially isolate factors related to differential treatment that could be targeted for improving quality of care.

The primary purpose of the present study was to determine whether CVD preventive care varied by patient gender among a random sample of US physicians using an experimental case-studies design. We also sought to examine whether awareness of and barriers to adoption of CVD prevention guidelines varied by physician specialty (primary care physicians [PCPs], obstetricians/gynecologists [OBGyns], and cardiologists [CARDs]).

Methods

Design

An online cross-sectional survey was administered to 500 physicians in November 2004 that included standardized questions about

From Columbia University College of Physicians and Surgeons, New York, NY (L.M., A.H.L.); Boston University School of Medicine, Boston, Mass (E.J.B.); Stanford University School of Nursing, Palo Alto, Calif (K.B.); Mayo Clinic College of Medicine, Rochester, Minn (S.N.H.); Brigham and Women's Hospital, Boston, Mass (B.W.W.); American Heart Association, Dallas, Tex (R.P.F.); and Segmentation Company, a Division of Yankelovich, Chapel Hill, NC (J.K., T.M., S.L.S.).

Correspondence to Dr Lori Mosca, NewYork–Presbyterian Hospital, Preventive Cardiology Program, 622 W 168th St, PH 10–203B, New York, NY 10032. E-mail ljm10@columbia.edu

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awareness of and barriers to CVD prevention guidelines. In addition, physicians were asked to choose preventive therapies that they recommend for patients at high, intermediate, and lower risk of CHD from a standard list. They were then given experimental case studies to test their knowledge of the National Cholesterol Education Program (NCEP) Adult Treatment Panel (ATP) III Framingham risk categories (high risk, 10-year absolute CHD risk >20%, established CVD, or CHD risk equivalent; intermediate risk, 10-year absolute CHD risk of 10% to 20%; or low risk, 10-year absolute risk <10%). The case studies subsequently tested the physicians' application of AHA evidence-based guidelines for women and the equivalent guidelines in men based on NCEP ATP III, the Joint National Committee on the Prevention, Detection, and Treatment of High Blood Pressure (JNC) 7, and AHA primary and secondary prevention recommendations.[9,11–14] Once physicians completed a survey question, they were not allowed to return to a previous question.

Physician CVD preventive practice patterns were assessed using a factorial case study design in which certain patient characteristics were varied and several others were held constant (Appendix 1). For purposes of this study, we tested specific hypotheses related to treatment variation by age, gender, race/ethnicity, LDL cholesterol, HDL cholesterol, and diabetes as a CHD risk equivalent because they were important new recommendations or were highlighted in the AHA evidence-based guidelines for women.[9] This approach allowed an evaluation of whether a factor such as gender drove treatment decisions when risk profiles were otherwise similar. Physicians were asked to assign a risk level (high, intermediate, low) to each case and then to recommend preventive therapies specific to that case. Because calculated risk could be compared with perceived risk, we were also able to assess determinants of assigning risk levels among the experimental cases.

Sample

The study was conducted among a stratified random sample of 500 physicians (300 PCPs, 100 OBGyns, and 100 CARDs) drawn from the J. Reckner Associates national database of >300 000 healthcare professionals. The research panel participants have been compiled over the years by multiple mechanisms (eg, random dialing, purchased samples, referrals) and are unbiased with respect to an artificially high concentration of Internet users. Regional samples for large population specialties are drawn by use of a "rolling over blocks" method to ensure that there is no overuse of samples within specialty.

A total of 8550 invitations were sent to physicians asking them to participate in an online study of treatment and prevention of CVD, and a small monetary incentive ($60 for PCPs, $75 for OBGyns and CARDs) was offered to qualified respondents who submitted completed surveys. The log in response rate was 13%, 10%, and 15% among PCPs, OBGyns, and CARDs, respectively, typical of a single mailing response rate for an epidemiological survey. In lieu of repeated mailings to the same physicians to improve the response, invitations were sent until the prespecified number of physician participants was attained by specialty category. Among the respondents, 74% of PCPs, 34% of OBGyns, and 61% of CARDs met eligibility criteria.

To qualify for the research study, physicians had to be board certified or board eligible in their respective specialties and be in full-time clinical practice for 3 to 30 years after residency. Each physician completed a standardized questionnaire that included demographic information, practice type and setting, and characteristics of patients in their practice. For purposes of this survey, PCPs had to spend ≥70% of their time in clinical practice, see ≥100 patients in a typical month, and treat ≥25% of their patients for hypertension or other CVD-related condition. OBGyns had to spend ≥50% of their time in clinical practice (with ≥30% in nonobstetric care), see ≥75 patients per month, treat ≥10% of patients for hypertension or other CVD-related conditions, and serve as the primary care provider for ≥30% of their patients. CARDs were eligible if they spent ≥50% of their time in clinical practice (with <50% of time doing interventional procedures), saw ≥75 patients in a typical month, and treated ≥50% of their patients for hypertension or other CVD-related conditions.

Experimental Cases

Each physician was presented 10 patient cases with information about age, sex, ethnicity/race, smoking status, total cholesterol, LDL cholesterol, HDL cholesterol, triglycerides, blood pressure, treatment for hypertension, body mass index (BMI), family history of CHD, and personal history of CHD or diabetes mellitus. Once physicians assigned a level of risk to each of the 10 cases, they were asked to specify their preventive treatment recommendations from a prespecified list of possible interventions.

Of the 10 cases, 2 were designed to be patients at low risk that differed only with regard to sex. In addition, there were 4 intermediate-risk and 4 high-risk cases with information about patient attributes that were generated from a balanced orthogonal design yielding 32 possible patient profiles. To reduce respondent fatigue, a subset of 16 patient profiles was selected for this study. The experimental design was developed with the SAS macro MktEx (SAS version 9.1.3). The profiles selected yielded a D-efficiency score of 100%. Each respondent was randomly selected to view 1 block of 4 intermediate-risk patient profiles and 1 block of 4 high-risk patient profiles, in addition to the 2 low-risk profiles, in random order. The factors varied and held constant within each risk category are presented in appendix 1.

The intermediate-risk factors that varied in the experimental design were age (42 versus 65 years), sex (male versus female), ethnicity (white versus black), LDL cholesterol (90 versus 162 mg/dL), and blood pressure (160/110 versus 118/78 mm Hg). Factors held constant in the intermediate-risk cases were nonsmoking status, HDL cholesterol of 56 mg/dL, triglycerides of 120 mg/dL, β-blocker antihypertensive treatment, BMI of 27 kg/m^2, positive family history of premature CHD, and no personal history of CVD. Among the high-risk cases, factors that were varied included age (50 versus 76 years), sex (male versus female), LDL cholesterol (90 versus 130 mg/dL), HDL cholesterol (42 versus 62 mg/dL), and personal history (CHD versus diabetes). Factors held constant in the high-risk cases were white race, nonsmoking, triglycerides of 100 mg/dL, blood pressure of 140/95 mm Hg, β-blocker therapy, BMI of 27 kg/m^2, and no family history of premature CHD.

Statistical Methods

Descriptive statistics of physician practices and preventive recommendations are presented as proportions and mean±SD. Differences in the percent of physicians making each type of preventive therapy recommendation by specialty were evaluated with t tests of proportion. We used χ^2 tests to assess concordance between NCEP ATP III calculated risk and physicians' assessed risk level.[11] Agreement with statements about physician effectiveness and prevention barriers/perceptions was evaluated by use of a 4-point (very effective versus others) and 10-point (strongly agree/agree versus others) Likert scale, respectively.

Cumulative, ordered logit models were used to evaluate the impact of experimentally designed patient factors on risk assessment. SAS PROC LOGISTIC (SAS version 9.1.3) was used to fit this model with physician risk assessment (low, intermediate, high) as the response variable and patient factors (age, gender, race/ethnicity, cholesterol level, blood pressure, patient history) as explanatory variables.

A step-wise (2 steps only) logistic regression model was used to investigate the effects of patient factors on physicians' therapy choices independently of assessment of risk. SPSS (version 12.0.1) logistic regression was used to fit this model with therapy choice (physical activity, cardiac rehabilitation, dietary counseling, weight reduction, dietary supplements, blood pressure medication, lipid-lowering medication, aspirin therapy) as the response variable (selected or not selected for ≥1 patient case in a risk group) and patient factors (age, gender, race/ethnicity, LDL cholesterol levels, blood pressure, patient history) as explanatory variables. Statistical significance was set at $P<0.05$.

Results

Physician/Practice Characteristics

The average time to complete the survey and experimental cases was 31.9±15.5 minutes. Characteristics of the survey respon-

TABLE 1. Characteristics of Physician Practices

	Physician Specialty		
	PCP (n=300)	OBGyn (n=100)	CARD (n=100)
Practice region			
East	27.3	29.0	40.0
West	16.0	15.0	16.0
South	32.7	37.0	27.0
Central	24.0	19.0	17.0
Practice type (solo)	26.7	36.0	23.0
Practice duration (≤10 y)	26.7	19.0	20.0
Patients ≥65 y of age	34.4 (15.0)	17.8 (10.4)	44.6 (11.5)
White patients	70.9 (23.0)	68.1 (18.3)	68.4 (21.2)
Female patients	57.0 (7.7)	100.0 (1.4)	50.1 (4.7)
Patients seen with hypertension in a typical month	40.8 (17.0)	19.5 (9.1)	55.8 (17.1)
Patients seen with dyslipidemia in a typical month	39.6 (16.2)	23.1 (11.8)	58.3 (17.0)
Patients with diabetes mellitus in a typical month	25.9 (13.2)	11.6 (8.6)	31.3 (12.9)

Values are % (SD).

dents' practices are provided in Table 1. The mean age of participating PCPs (internal medicine/general or family practitioners) was 47±8 years; OBGyns, 49±8 years; and CARDs, 50±8 years. Mean time in practice (since completing residency) was 16±7 years for PCPs, 18±7 years for OBGyns, and 17±7 years for CARDs. The sample was made up primarily of male physicians (81% PCPs, 85% OBGyns, 98% CARDs). By design, physicians differed in the proportion of patients who were female and the proportion of patients seen in a typical month for hypertension and other CVD-related conditions. OBGyns were more often in solo practice and had the smallest proportion of older patients. PCPs were in practice ≤10 years more frequently than OBGyns or CARDs.

Awareness/Incorporation of CVD Prevention Guidelines

Physician awareness of 3 national CVD prevention guidelines (NCEP ATP III, JNC 7, and AHA Evidence-Based Guidelines for Women) differed by physician specialty and guideline as illustrated in Figure 1. Among PCPs and CARDs, there was a high level of awareness of NCEP ATP III and JNC 7 guidelines. Awareness of the more recent AHA Evidence-Based Guidelines for Women was lower than NCEP ATP III and JNC 7 and highest among CARDs (80%). OBGyns were more aware of the AHA women's guidelines than JNC 7 and had similar familiarity with the AHA women's guidelines and NCEP ATP III.

Figure 2 shows self-reported incorporation of guidelines into practice among those who responded that they were aware of specific guidelines. CARDs and PCPs were similar in their reported use of guidelines and were significantly more likely to report incorporation of each of the 3 guidelines into their practice than OBGyns.

Lifestyle, Supplement, and Aspirin Recommendations

Physician's recommendations about lifestyle interventions, supplements, and aspirin therapy by physician specialty according to patient risk level are presented in Table 2. Of note, recommendations for lifestyle interventions (physical activity and dietary counseling) were suboptimal among low-risk patients across all physician specialties, even though lifestyle strategies to prevent CVD are recommended for all women in the AHA women's guidelines (Appendix 2) and are a first-line approach for

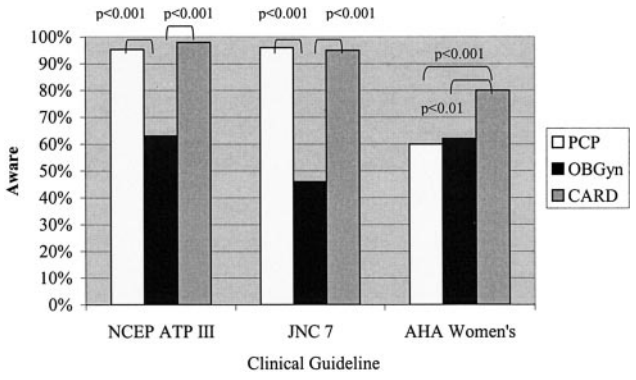

Figure 1. Physician awareness of CVD prevention guidelines by specialty.

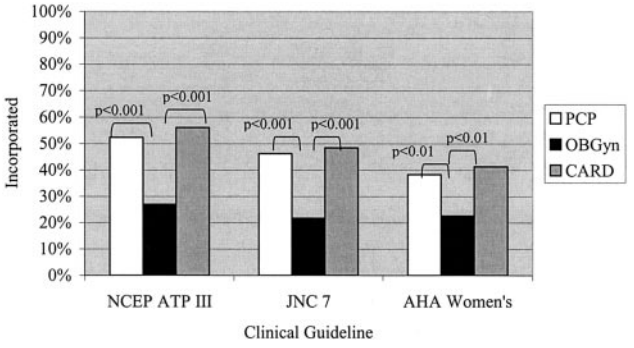

Figure 2. Physician incorporation of CVD prevention guidelines by specialty among respondents who stated they were aware of the guideline.

TABLE 2. Physicians' Lifestyle, Supplement, and Aspirin Recommendations by Specialty and Patient Risk Level

	Patient Risk Level								
	Low			Intermediate			High		
	PCP (A) (n=300)	OBGyn (B) (n=100)	CARD (C) (n=100)	PCP (A) (n=300)	OBGyn (B) (n=100)	CARD (C) (n=100)	PCP (A) (n=300)	OBGyn (B) (n=100)	CARD (C) (n=100)
Physical activity	67.6	59.0	57.0	96.3	96.0	97.0	93.3	92.0	92.0
Dietary counseling	58.0[B,C]	46.0[A]	46.0[A]	92.6[B]	98.0[A,C]	87.0[B]	89.6	90.0	85.0
Supplements	10.3	8.0	4.0	23.3[B]	34.0[A,C]	16.0[B]	21.6	29.0[C]	13.0[B]
Aspirin therapy	32.6	37.0	29.0	84.3	85.0	86.0	89.6	84.0	86.0

Values are percentages. Superscript letters indicate statistically significant differences at $P<0.05$ using a t test of proportions.

national cholesterol and blood pressure management guidelines and AHA primary prevention guidelines.[9,11–13]

Physicians reported spending an average of 8 minutes counseling their patients on lifestyle change at routine annual visits. However, <5% of physicians advised patients to engage in physical activity ≥6 days per week as recommended by national guidelines. Most dietary counseling was provided by the physician among the low- and intermediate-risk patients, whereas physicians were more likely to refer high-risk patients to nutritionists for dietary counseling. Among those physicians who provided dietary counseling, specific recommendations were consistent with AHA guidelines. The strategy to reduce trans fatty acid intake was the least reported dietary recommendation to prevent CVD across risk groups. The overwhelming majority of physicians did not specify an exact target for saturated fat intake when counseling their patients about diet to prevent CVD.

OBGyns were more likely to recommend supplements to prevent CVD than PCPs or CARDs, although the AHA women's guidelines do not strongly recommend this strategy and suggest that antioxidant supplements should not be used for CVD prevention (Appendix 2). Each physician group recommended supplements more frequently among intermediate-risk and high-risk patients than low-risk patients. The 3 most common supplements that physicians recommended were multivitamin/mineral, omega-3 fatty acids, and folic acid. Consistent with AHA women's guidelines, recommendations for aspirin therapy varied by risk level, with patients at high risk more likely to receive a recommendation (90% PCPs, 84% OBGyns, 86% CARDs) and about one third of physician recommending aspirin therapy for low-risk patients (Appendix 2).[9] The most frequently recommended dose was 81 mg. However, one third of PCPs and CARDs recommended 325 mg for the high-risk patient, despite guidelines suggesting a dose range of 75 to 162 mg daily.

Lipid, Diabetes, and Blood Pressure Management

General recommendations (not case specific) for high-risk patients for management of lipids, including diet therapy, physical activity, smoking cessation, and pharmacotherapy, by physician specialty are listed in Table 3. OBGyns were less likely than PCPs and CARDs to recommend diet therapy and statins indicated in high-risk patients regardless of LDL in the AHA women's guidelines (Appendix 2).[9] They were more likely to recommend dietary supplemental niacin or over-the-counter niacin as initial LDL cholesterol–lowering therapy, inconsistent with the guidelines (Table 3). Similarly, for initial treatment of HDL cholesterol, OBGyns were less likely to use prescription niacin or fibrates compared with PCPs and CARDs and were less likely to recommend physical activity compared with PCPs, although these are recommended by the AHA for high-risk women (Table 3). Also, OBGyns were less likely to recommend fibrates, prescription niacin, and dietary therapy for the management of triglycerides in high-risk women (Table 3).

Table 4 shows the percent of physicians by specialty that identified various optimal lipid and glucose targets stratified by patient gender. About half of the sample identified optimal LDL levels as <100 mg/dL (2.59 mmol/L) consistent with NCEP ATP III and AHA women's guidelines.[9,11] Five percent of OBGyns and 23% of CARDs suggested an LDL level <70 mg/dL (1.81 mmol/L) as an optimal level, in line with the recommendations of the recent update to NCEP ATP III.[15] The data show that physicians recognized gender differences in optimal HDL levels and that 50% of CARDs correctly identified the optimal HDL level of >50 mg/dL (1.30 mmol/L) recommended for women in the AHA guidelines. OBGyns were less likely to correctly identify optimal triglyceride levels (<150 mg/dL, 1.70 mmol/L) and an optimal HbA1C level of <7.0% compared with PCPs and CARDs.

Most PCPs (92%) and CARDs (90%) recommended further antihypertensive drug therapy for high-risk patients who were already on β-blocker therapy and had a blood pressure of 140/95 mm Hg (Table 5); OBGyns were less likely to do so compared with either PCPs or CARDs (69%, $P<0.01$). Similar trends were observed for intermediate-risk cases. The most frequently recommended medication to manage hypertension was ACE inhibitors or angiotensin receptor blockers, followed by diuretics, although national guidelines suggest that diuretics should be part of the antihypertensive drug regimen for most patients unless contraindicated. Calcium channel blockers were more commonly recommended as antihypertensive therapy in the intermediate- compared with the high-risk group.

Framingham/ATP III Risk Versus Perceived Risk

Physicians' perceptions of patients' risk levels were compared with calculated risk category based on ATP III Framingham risk scores, stratified by patient gender and physician specialty.[11] Among PCPs, 34% correctly categorized low-risk male patients, 47% correctly categorized intermediate-risk male patients, and 59% correctly identified high-risk male patients. A similar trend was seen for PCPs' evaluation of female patients (43%, 47%, and 55%, respectively).

TABLE 3. LDL, HDL, and Triglyceride Management in High-Risk* Patients by Physician Specialty

	Physician Specialty		
	PCP (A) (n=300)	OBGyn (B) (n=100)	CARD (C) (n=100)
LDL management			
Lifestyle approach			
Diet therapy	80.3[B]	67.0[A,C]	80.0[B]
Physical activity	76.0[B]	65.0[A]	74.0
Smoking cessation	69.7	64.0	61.0
Pharmacological approach			
Statin	80.0[B]	58.0[A,C]	87.0[B]
Bile acid resins	3.0	3.0	3.0
Cholesterol absorption inhibitor	9.0	7.0	10.0
Single pill statin/cholesterol absorption inhibitor	13.7[B]	6.0[A]	9.0
Fibrates	6.7	8.0	3.0
Prescription niacin	10.3	7.0	8.0
Dietary supplement or OTC niacin	7.3[B]	14.0[A,C]	4.0[B]
Single pill statin/niacin	6.7	8.0	11.0
HDL management			
Lifestyle approach			
Diet therapy	70.0	66.0	72.0
Physical activity	79.3[B]	69.0[A]	81.0
Smoking cessation	65.0	62.0	63.0
Pharmacological approach			
Statin	42.0	46.0	41.0
Bile acid resins	1.7		1.0
Cholesterol absorption inhibitor	3.7	5.0	3.0
Single pill statin/cholesterol absorption inhibitor	5.7	5.0	8.0
Fibrates	14.7[B]	4.0[A,C]	12.0[B]
Prescription niacin	38.0[B]	8.0[A,C]	45.0[B]
Dietary supplement or OTC niacin	9.7	13.0	11.0
Single pill statin/niacin	12.0	10.0	17.0
Triglyceride management			
Lifestyle approach			
Diet therapy	82.0[B]	69.0[A,C]	84.0[B]
Physical activity	75.7	68.0	77.0
Smoking cessation	62.3	62.0	58.0
Pharmacological approach			
Statin	36.7	42.0	40.0
Bile acid resins	5.0	3.0	3.0
Cholesterol absorption inhibitor	2.3	6.0	3.0
Single pill statin/cholesterol absorption inhibitor	5.3	6.0	7.0
Fibrates	50.7[B]	16.0[A,C]	57.0[B]
Prescription niacin	19.3[B]	8.0[A,C]	25.0[B]
Dietary supplement or OTC niacin	10.0	12.0	5.0
Single pill statin/niacin	7.7	7.0	12.0

Values are percentages. OTC indicates over the counter. Superscript letters indicate statistically significant differences at $P<0.05$, using a *t* test of proportions.

*Data for other risk groups not presented.

Among OBGyns, 19% correctly identified male patient's risk as low, 41% correctly categorized intermediate-risk patients, and 43% correctly categorized high-risk patients. In their assessment of female patients' risk, OBGyns' accuracy rates were 17%, 38%, and 37%, respectively. CARDs correctly categorized low-risk male patients 29% of the time, 51% correctly categorized intermediate-risk male patients, and 58% correctly identified high-risk male patients. A similar trend was seen for CARDs' evaluation of female patients' risk level (36%, 53%, and 56%, respectively).

Data on determinants of physicians assigning increasing risk levels among patients calculated to be at intermediate and high risk as defined by NCEP ATP III reveal a significant influence of patient gender on assignment of risk category (Table 6). Intermediate-risk women were significantly less likely to be assigned to a higher-risk category than men with similar risk profiles (OR, 0.62; 95% CI, 0.49 to 0.78) by PCPs, with similar but nonsignificant trends for OBGyns and CARDs. For example, PCPs assigned 20% of women compared with 13% of men to the low-risk category with the same risk profile (65 years of age, nonsmoking, LDL cholesterol of 162 mg/dL, HDL cholesterol of 56 mg/dL, BMI of 27 kg/m^2, blood pressure of 118/78 mm Hg, positive family history of premature CHD, and no personal history of CVD).

Guideline Adherence by Patient Risk Level

Physicians' assessment of the patient as intermediate or high risk significantly predicted recommendations for preventive interventions (physical activity, cardiac rehabilitation, dietary therapy, weight reduction, blood pressure control, lipid management, and aspirin therapy) in the experimental case studies among all specialties combined. After assignment of risk by physician was taken into consideration, older high-risk patients were less likely to receive recommendations for dietary counseling ($P=0.03$) and weight reduction ($P<0.01$) and were more likely to receive a recommendation for aspirin therapy ($P=0.05$) than younger patients. As expected, high-risk patients with elevated LDL cholesterol levels were more likely to receive a recommendation for lipid pharmacotherapy ($P<0.01$) and dietary counseling ($P=0.02$). Diabetics were more likely to be recommended dietary therapy ($P<0.01$) and less likely to receive a recommendation for cardiac rehabilitation than patients with CHD ($P<0.01$). HDL cholesterol levels were not associated with preventive recommendations among the high-risk cases.

Among intermediate-risk cases, increased age was predictive of a physician recommendation for aspirin therapy ($P<0.01$). As expected, intermediate-risk cases with elevated LDL cholesterol levels were more likely to be recommended dietary counseling ($P=0.01$) and lipid pharmacotherapy ($P<0.01$). Similarly, antihypertensive drug therapy was more frequently recommended among cases with elevated blood pressure ($P<0.01$). After adjustment for physician assignment of risk level, women calculated to be at intermediate risk by NCEP ATP III received significantly more recommendations for weight reduction ($P=0.04$) and less frequent recommendations for aspirin therapy ($P<0.01$), suggesting that factors beyond perceived risk may also contribute to gender differences in some therapeutic choices.

TABLE 4. Identification of Optimal Levels of Lipid and Glycemic Control by Patient Gender and Physician Specialty

	Male			Female		
	PCP (A) (n=300)	OBGyn (B) (n=100)	CARD (C) (n=100)	PCP (A) (n=300)	OBGyn (B) (n=100)	CARD (C) (n=100)
LDL <100 mg/dL	54.3	...	53.0	54.0	54.0	54.0
LDL <70 mg/dL	11.7[C]	...	23.0[A]	10.3[C]	5.0[C]	23.0[A,B]
HDL >40 mg/dL	37.8	...	39.0	16.1[C]	13.0	6.0[A]
HDL >50 mg/dL	17.4	...	24.0	35.8[C]	39.0	50.0[A]
TG <150 mg/dL	62.0	...	62.0	61.3[B]	28.0[A,C]	61.0[B]
$HbA1_C$ <7%	13.7	...	16.0	13.3[B]	5.0[A,C]	16.0[B]
FPG <100 mg/dL	38.0	...	42.0	39.0	29.0[C]	43.0[B]

Values are percentages. TG indicates triglycerides; FPG, fasting plasma glucose. To convert values for LDL and HDL cholesterol from mg/dL to mmol/L, multiply by 0.02586; for TG, multiply by 0.0113; for FPG, multiply by 0.0555. Superscript letters indicate statistically significant differences at $P<0.05$ using a *t* test of proportions.

Among the low-risk cases in which only gender varied, sex was not a significant predictor of recommendations for CVD preventive therapy.

Physician Effectiveness and Barriers to Adherence

Physicians in this study did not rate themselves as very effective in their ability to help patients prevent CVD and manage risk factors (Table 7). In particular, OBGyns did not rate themselves as very effective in helping patients achieve lifestyle change such as weight management, smoking cessation, and physical activity and felt less effective in managing lipids, controlling blood pressure, and preventing heart disease in their patients compared with PCPs and CARDs.

Twenty-six percent of PCPs, 11% of OBGyns, and 28% of CARDs reported having a system in place to track patient adherence to prescription regimens, with OBGyns being less likely to have such a system ($P<0.05$). Of those who reported having a system to track patient's medication adherence, most cited a standard query at the patient's visit as the method used.

Barriers to guideline adherence cited by physicians are listed in Table 8. A substantial percent of physicians strongly agreed or agreed that the patient was the greatest barrier to prevention of CVD. Lack of time for primary prevention was also a common barrier cited by OBGyns and PCPs, as was lack of insurance coverage for lifestyle interventions. OBGyns were less concerned that treatment guidelines be published by professionals within their own specialty compared with CARDs. Only a small proportion of physicians agreed that the results of clinical research to determine optimal risk-reducing interventions in men generalize to women.

Many physicians reported that they are willing to seek additional training that will allow them to better engage in preventive health treatment for CVD in women, with the greatest enthusiasm among OBGyns. Despite documentation that more women die of CVD each year than men, surprisingly few physicians (<1 in 5) from any of the specialties strongly agreed or agreed with that fact.

TABLE 5. Pharmacological Management of Blood Pressure in Intermediate- and High-Risk* Patients by Physician Specialty†

	Patient Risk Level					
	Intermediate			High		
	PCP (A) (n=300)	OBGyn (B) (n=100)	CARD (C) (n=100)	PCP (A) (n=300)	OBGyn (B) (n=100)	CARD (C) (n=100)
Overall	49.0	48.0	52.0	92.0[B]	69.0[A,C]	90.0[B]
Diuretics	57.3[B]	38.6[A,C]	42.5[A]	38.2[C]	45.5[C]	25.0[A,B]
ACE/ARBs	62.4[B]	50.0[A,C]	71.5[B]	76.9[B]	45.5[A,C]	84.2[B]
CCBs	17.6	19.0	21.2	6.4	9.1	5.3
β-Blockers	8.6	4.9	10.9	7.9	5.1	8.6
Other	1.1[B]	4.9[A]	1.0	0.5[B]	3.6[A]	0.3

Values are percentages. ARBs indicates angiotensin II receptor blockers; CCBs, calcium channel blockers. Superscript letters indicate statistically significant differences at $P<0.05$ using a *t* test of proportions.

*Data for low-risk group not presented. †Data are among physicians who recommended pharmacological blood pressure management for ≥1 patient case who fall into the given risk category.

TABLE 6. Predictors of Physician's Assignment of Increased Risk Level Among True Intermediate-Risk Cases and High-Risk Cases

	Physician Specialty		
	PCP, OR (95% CI)	OBGyn, OR (95% CI)	CARD, OR (95% CI)
Intermediate-risk cases			
Age	1.40 (1.10–1.77)	1.77 (1.13–2.75)	1.60 (1.05–2.43)
Gender	0.62 (0.49–0.78)	0.88 (0.57–1.37)*	0.71 (0.47–1.08)*
Race/ethnicity	1.48 (1.17–1.87)	1.20 (0.77–1.86)*	0.84 (0.55–1.28)*
LDL	5.98 (4.66–7.69)	8.97 (5.49–14.66)	8.65 (5.45–13.71)
Blood pressure	12.92 (9.79–17.06)	50.81 (27.71–93.16)	14.05 (8.53–23.14)
High-risk cases			
Age	1.30 (1.04–1.64)	1.21 (0.83–1.77)*	1.44 (0.97–2.14)
Gender	0.85 (0.68–1.07)*	0.86 (0.59–1.26)*	0.86 (0.58–1.27)*
LDL	1.83 (1.46–2.30)	1.66 (1.13–2.42)	1.82 (1.23–2.71)
HDL	1.09 (0.87–1.36)*	1.18 (0.81–1.73)*	1.08 (0.73–1.59)*
DM	1.58 (1.26–1.98)	1.15 (0.79–1.68)*	1.34 (0.90–1.99)*

Cumulative, ordered logit model.

See Appendix 1; Age: older vs younger; gender: female vs male; race/ethnicity: black vs white; LDL: higher vs lower; blood pressure: higher vs lower; HDL: higher vs lower; DM: diabetes mellitus vs coronary heart disease.

*Nonsignificant logit coefficient.

Discussion

Two main findings from this national study were that recommendations for CVD prevention were driven by risk level assignment and that women were more likely than men to be assigned a lower-risk category despite a similar calculated risk. These data are concordant with a study by Shulman et al,[16] which found that gender independently influenced how physicians managed chest pain. In that study, PCPs were given a computerized survey instrument incorporating taped interviews of actors portraying patients and asked to assess risk and to make recommendations about further care. Physician estimates of the probability of CHD were lower for women, and despite adjustment for estimate of probability of disease, level of coronary risk, and presenting symptoms, women were less likely to be referred for diagnostic cardiac catheterization. Both studies suggest that improving physician assessment of CHD risk may be an important educational target to reduce sex-based disparities in care.

Our study also showed that awareness and incorporation of CVD prevention guidelines differed by type of physician. OBGyns were substantially less aware of national guidelines for cholesterol and blood pressure management than PCPs, consistent with a lower reported rate of incorporation into their practice and lower self-reported effectiveness in managing major CHD risk factors and preventing heart disease. Because OBGyns in our study reported that they provided

TABLE 7. Physician Self-Reported Effectiveness by Specialty*

	Physician Specialty		
	PCP (A) (n=300)	OBGyn (B) (n=100)	CARD (C) (n=100)
Understanding the risk of heart disease	44.3[B,C]	28.0[A,C]	58.0[A,B]
Manage their weight	10.0	7.0	8.0
Stop smoking	13.7	11.0	13.0
Maintain an adequate level of physical activity	12.7	9.0	12.0
Eat a "heart-healthy" diet	11.7	11.0	13.0
Lower LDL cholesterol to <130 mg/dL	42.7[B,C]	12.0[A,C]	67.0[A,B]
Increase HDL cholesterol to >50 mg/dL	9.3[C]	11.0	19.0[A]
Keep blood pressure at ≤120/80 mm Hg	30.3[B]	16.0[A,C]	32.0[B]
Prevent a heart attack	20.7[B,C]	3.0[A,C]	33.0[A,B]
Take medications as prescribed	14.7[B]	7.0[A,C]	23.0[B]

Values are percentages. To convert values for LDL and HDL cholesterol from mg/dL to mmol/L, multiply by 0.02586. Superscript letters indicate statistically significant differences at $P<0.05$ using a t test of proportions.

*Physicians who stated that they were very effective on a 4-point Likert scale.

TABLE 8. Physician's Agreement With Statements About CVD Prevention and Guidelines*

	Physician Specialty		
	PCP (A) (n=300)	OBGyn (B) (n=100)	CARD (C) (n=100)
Although I agree in principle that more primary prevention should be done with patients, the time constraints of a "typical" patient visit simply don't allow it.	23.3[C]	30.0[C]	7.0[A,B]
If insurance companies provided better coverage for lifestyle interventions (such as weight loss and smoking cessation), I would spend more time doing it.	31.0[C]	30.0	19.0[A]
The greatest barrier to prevention of heart disease is the patient him/herself.	28.7[C]	37.0[C]	18.0[A,B]
I am more likely to adopt into my practice treatment guidelines that are published by professionals within my specialty.	19.0[C]	14.0[C]	36.0[AB]
The existence of multiple treatment guidelines, each with somewhat different recommendations, makes it difficult to determine which is the best to use with my patients.	10.0	16.0[C]	4.0[B]
More women than men die each year of CVD.	8.3[C]	13.0	17.0 [A]
I am willing to seek additional training that will allow me to better engage in preventive health treatments for CVD in women.	28.0[B]	43.0[A,C]	25.0[B]
By and large, the results of clinical research to determine optimal risk-reducing interventions in men generalize to women.	8.3	4.0[C]	14.0 [B]

Values are percentages. Superscript letters indicate statistically significant differences at $P<0.05$ using a *t* test of proportions.
*Physicians who stated that they agree or strongly agree on a 10-point Likert scale.

primary care to 67% of their patients, they can play a vital role in assessing and managing CVD risk among women. It was encouraging that most OBGyns in our study were willing to adopt guidelines published by professionals outside their specialty. The American College of Obstetrics and Gynecology was a major cosponsor of the AHA evidence-based guidelines for CVD prevention in women, and our data show that OBGyns were more aware of these guidelines than JNC 7, suggesting that partnerships to develop and disseminate female-specific guidelines may be an effective strategy to improve the quality of preventive care.

According to our study, fewer than two thirds of physicians recommended physical activity to low-risk patients, and only about half advised dietary counseling. This finding is similar to that of the National Ambulatory Medial Care Survey, which found low rates of lifestyle counseling in practice that was worse for women than men.[8] An educational opportunity exists for all physicians to encourage lifestyle strategies to prevent the development of risk factors that may require more intensive therapy later. We also observed significant prospects to improve adherence to national guidelines for lipid management, especially among the high-risk patients who are most likely to benefit. Recently, statin therapy has been recommended for high-risk patients regardless of LDL cholesterol level,[9,11] yet only about half of OBGyns recommended such therapy when treating high-risk patients. Similarly, the AHA women's guidelines recommended niacin or fibrate therapy when HDL-cholesterol was low or non–HDL-cholesterol was elevated among high-risk women, and only one third of OBGyns recommended such therapy. Our data also suggest that more education is needed with regard to optimal glucose and blood pressure management.

Barriers to CVD preventive care in our study (lack of time and reimbursement) were similar to other data and suggest that policy makers and insurers need to address systems constraints to better serve public health.[10] Although many physicians suggested that the patient was an important barrier to the prevention of heart disease, this may reflect the perceived difficulty in adherence to lifestyle factors that are within the control of the patient and crucial for preventing CVD. A potential sex-specific barrier cited by a large percent of physicians was that results of clinical research conducted in men may not generalize to women, emphasizing the importance of including women in CVD prevention studies to increase adoption of evidence-based guidelines. Finally, a striking finding in our study was a very low level of recognition (8% PCPs, 13% OBGyns, and 17% CARDs) that heart disease kills more women every year than men. According to AHA statistics, nearly 500 000 women die of CVD each year, exceeding the number of men.[1] These physician data underscore the need for awareness campaigns about women and heart disease among healthcare providers, especially because awareness of risk is a critical first step in taking action to reduce it.

Our study has limitations. The results may not be generalizable to all physicians because our response rate was low and we did not survey every specialty. However, our data may represent a best-case scenario among full-time practitioners because survey respondents may be more likely to be aware of and adhere to guidelines as a result of selection bias. Our power to evaluate recommendations among low-risk cases was reduced as a result of the limited number of low-risk profiles by design because of cost constraints. The additive effects of risk assignment and independent risk factors on therapy choice were not evaluated in the present analysis. We also lacked the power to examine whether awareness of, adoption of, and barriers to treatment varied by age, gender, or race/ethnicity of the physician. In addition, we conducted multiple analyses without adjusting for statistical testing. Our results will need to be validated in other cohorts and by other study designs.

In conclusion, interventions to raise awareness and adoption of CVD prevention guidelines among healthcare providers are needed. Educational efforts should be targeted to assisting physicians in CHD risk assessment, which may help reduce sex-based disparities in preventive care. Further research into effective strategies to improve physician and patient adherence to CVD prevention guidelines is merited.

Appendix 1

APPENDIX 1. Experimental Patient Cases

Cases	Factors	Level(s)	
Low-risk cases			
Variable levels	Sex	Male	Female
Constant levels	Age	42 y	
	Smoking	No	
	Total cholesterol	273 mg/dL	
	LDL cholesterol	195 mg/dL	
	HDL cholesterol	52 mg/dL	
	Triglycerides	132 mg/dL	
	Hypertension	118/78 mm Hg	
	Hypertension treated	No	
	BMI	24 kg/m^2	
	Family history	None	
	Personal history	None	
Intermediate-risk cases			
Variable levels	Age	42 y	65 y
	Sex	Male	Female
	Race/ethnicity	White	Black
	LDL cholesterol	90 mg/dL	162 mg/dL
	Hypertension	118/78 mm Hg	160/110 mm Hg
Constant levels	Smoking	No	
	HDL cholesterol	56 mg/dL	
	Triglycerides	120 mg/dL	
	Hypertension treated	β-Blocker	
	BMI	27 kg/m^2	
	Family history	Premature CHD	
	Personal history	None	
High-risk cases			
Variable levels	Age	50 y	76 y
	Sex	Male	Female
	LDL cholesterol	90 mg/dL	130 mg/dL
	HDL cholesterol	42 mg/dL	62 mg/dL
	Personal history	CHD	Diabetes
Constant levels	Race/ethnicity	White	
	Smoking	No	
	Triglycerides	100 mg/dL	
	Hypertension	140/95 mm Hg	
	Hypertension treated	β-Blocker	
	BMI	27 kg/m^2	
	Family history	Premature CHD	

Appendix 2

APPENDIX 2. Clinical Recommendations

Lifestyle interventions

Cigarette smoking
Consistently encourage women not to smoke and to avoid environmental tobacco. (Class I, Level B)$_{GI=1}$

Physical activity
Consistently encourage women to accumulate a minimum of 30 minutes of moderate-intensity physical activity (eg, brisk walking) on most, and preferably all, days of the week. (Class I, Level B)$_{GI=1}$

Cardiac rehabilitation
Women with a recent acute coronary syndrome or coronary intervention, new-onset or chronic angina should participate in a comprehensive risk-reduction regimen, such as cardiac rehabilitation or a physician-guided home- or community-based program. (Class I, Level B)$_{GI=2}$

Heart-healthy diet
Consistently encourage an overall healthy eating pattern that includes intake of a variety of fruits, vegetables, grains, low-fat or nonfat dairy products, fish, legumes, and sources of protein low in saturated fat (eg, poultry, lean meats, plant sources). Limit saturated fat intake to $<$10% of calories, limit cholesterol intake to $<$300 mg/d, and limit intake of *trans* fatty acids. (Class I, Level B)$_{GI=1}$

Weight maintenance/reduction
Consistently encourage weight maintenance/reduction through an appropriate balance of physical activity, caloric intake, and formal behavioral programs when indicated to maintain/achieve a BMI between 18.5 and 24.9 kg/m^2 and a waist circumference $<$35 in. (Class I, Level B)$_{GI=1}$

Psychosocial factors
Women with CVD should be evaluated for depression and refer/treat when indicated. (Class IIa, Level B)$_{GI=2}$

Omega 3 fatty acids
As an adjunct to diet, omega 3 fatty-acid supplementation may be considered in high-risk* women. (Class IIb, Level B)$_{GI=2}$

Folic acid
As an adjunct to diet, folic acid supplementation may be considered in high-risk* women (except after revascularization procedure) if a higher-than-normal level of homocysteine has been detected. (Class IIb, Level B)$_{GI=2}$

Major risk factor interventions

Blood pressure—lifestyle
Encourage an optimal blood pressure of $<$120/80 mm Hg through lifestyle approaches. (Class I, Level B)$_{GI=1}$

Blood pressure—drugs
Pharmacotherapy is indicated when blood pressure is $\geq$140/90 mm Hg or an even lower blood pressure in the setting of blood pressure–related target-organ damage or diabetes. Thiazide diuretics should be part of the drug regimen for most patients unless contraindicated. (Class I, Level A)$_{GI=1}$

Lipid, lipoproteins
Optimal levels of lipids and lipoproteins in women are LDL-C $<$100 mg/dL, HDL-C $>$50 mg/dL, triglycerides $<$150 mg/dL, and non–HDL-C (total cholesterol minus HDL cholesterol) $<$130 mg/dL and should be encouraged through lifestyle approaches. (Class I, Level B)$_{GI=1}$

Lipids—diet therapy
In high-risk women or when LDL-C is elevated, saturated fat intake should be reduced to $<$7% of calories, cholesterol to $<$200 mg/d, and *trans* fatty acid intake should be reduced. (Class I, Level B)$_{GI=1}$

Lipids—pharmacotherapy—high risk*
Initiate LDL-C–lowering therapy (preferably a statin) simultaneously with lifestyle therapy in high-risk women with LDL-C $\geq$100 mg/dL (Class I, Level A)$_{GI=1}$, and initiate statin therapy in high-risk women with an LDL-C $<$100 mg/dL unless contraindicated (Class I, Level B)$_{GI=1}$.

Initiate niacin§ or fibrate therapy when HDL-C is low, or non–HDL-C elevated in high-risk women. (Class I, Level B)$_{GI=1}$

Lipids—pharmacotherapy—intermediate risk†
Initiate LDL-C–lowering therapy (preferably a statin) if LDL-C level is $\geq$130 mg/dL on lifestyle therapy (Class I, Level A)$_{GI=1}$, or niacin§ or fibrate therapy when HDL-C is low or non–HDL-C elevated after LDL-C goal is reached. (Class I, Level B)$_{GI=1}$

Lipids—pharmacotherapy—lower risk‡
Consider LDL-C–lowering therapy in low-risk women with 0 or 1 risk factor when LDL-C level is $\geq$190 mg/dL or if multiple risk factors are present when LDL-C is $\geq$160 mg/dL (Class IIa, Level B) or niacin§ or fibrate therapy when HDL-C is low or non–HDL-C elevated after LDL-C goal is reached. (Class IIa, Level B)$_{GI=1}$

Diabetes
Lifestyle and pharmacotherapy should be used to achieve near normal HbA_{1C} ($<$7%) in women with diabetes. (Class I, Level B)$_{GI=1}$

GI indicates generalizability index; LDL-C, low-density lipoprotein cholesterol; HDL-C, high-density lipoprotein cholesterol; ACE, angiotensin-converting enzyme; and ARB, angiotensin receptor blocker.

*High risk is defined as CHD or risk equivalent, or 10-year absolute CHD risk $>$20%.

†Intermediate risk is defined as 10-year absolute CHD risk 10% to 20%.

‡Lower risk is defined as 10-year absolute CHD risk $<$10%.

§Dietary supplement niacin must not be used as a substitute for prescription niacin, and over-the-counter niacin should only be used if approved and monitored by a physician.

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APPENDIX 2. Continued

Preventive drug interventions

Aspirin—high risk*

Aspirin therapy (75 to 162 mg), or clopidogrel if patient is intolerant to aspirin, should be used in high-risk women unless contraindicated. (Class I, Level A)$_{GI=1}$

Aspirin—intermediate risk†

Consider aspirin therapy (75 to 162 mg) in intermediate-risk women as long as blood pressure is controlled and benefit is likely to outweigh risk of gastrointestinal side effects. (Class IIa, Level B)$_{GI=2}$

β-Blockers

β-Blockers should be used indefinitely in all women who have had a myocardial infarction or who have chronic ischemic syndromes unless contraindicated. (Class I, Level A)$_{GI=1}$

ACE inhibitors

ACE inhibitors should be used (unless contraindicated) in high-risk* women. (Class I, Level A)$_{GI=1}$

ARBs

ARBs should be used in high-risk* women with clinical evidence of heart failure or an ejection fraction $<$40% who are intolerant to ACE inhibitors. (Class I, Level B)$_{GI=1}$

Atrial fibrillation/stroke prevention

Warfarin—atrial fibrillation

Among women with chronic or paroxysmal atrial fibrillation, warfarin should be used to maintain the INR at 2.0 to 3.0 unless they are considered to be at low risk for stroke ($<$1%/y) or high risk of bleeding. (Class I, Level A)$_{GI=1}$

Aspirin—atrial fibrillation

Aspirin (325 mg) should be used in women with chronic or paroxysmal atrial fibrillation with a contraindication to warfarin or at low risk for stroke ($<$1%/y). (Class I, Level A)$_{GI=1}$

Class III interventions

Hormone therapy

Combined estrogen plus progestin hormone therapy should not be initiated to prevent CVD in postmenopausal women. (Class III, Level A)

Combined estrogen plus progestin hormone therapy should not be continued to prevent CVD in postmenopausal women. (Class III, Level C)

Other forms of menopausal hormone therapy (eg, unopposed estrogen) should not be initiated or continued to prevent CVD in postmenopausal women pending the results of ongoing trials. (Class III, Level C)

Antioxidant supplements

Antioxidant vitamin supplements should not be used to prevent CVD pending the results of ongoing trials. (Class III, Level A)$_{GI=1}$

Aspirin—lower risk‡

Routine use of aspirin in lower-risk women is not recommended pending the results of ongoing trials. (Class III, Level B)$_{GI=2}$

GI indicates generalizability index; LDL-C, low-density lipoprotein cholesterol; HDL-C, high-density lipoprotein cholesterol; ACE, angiotensin-converting enzyme; and ARB, angiotensin receptor blocker.

*High risk is defined as CHD or risk equivalent, or 10-year absolute CHD risk $>$20%.

†Intermediate risk is defined as 10-year absolute CHD risk 10% to 20%.

‡Lower risk is defined as 10-year absolute CHD risk $<$10%.

§Dietary supplement niacin must not be used as a substitute for prescription niacin, and over-the-counter niacin should only be used if approved and monitored by a physician.

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